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(Translation)

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Date of Application : August 29, 2000

Applicant : LG. Philips LCD Co., Ltd.

Commissioner

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[Title of Invention] IN PLANE SWITCHING MODE LIQUID CRYSTAL DISPLAY DEVICE
[Applicant]
[Name] LG. Philips LCD Co., Ltd.
[Applicant Code] 1-1998-101865-5
[Attorney]
[Name] Yong In KIM
[Attorney Code] 9-1998-000022-1
[Registered number of General Power of Attorney] 1999-054732-1
[Attorney]
[Name] Chang Sub SHIM
[Attorney Code] 9-1998-000279-9
[Registered number of General Power of Attorney] 1999-054731-4
[Inventor]
[Name] Yun Bok LEE
[Resident Reg.] 670110-1047012
[Postal] 121-080
[Address] 43-8, Daeheung-dong, Mapo-gu, Seoul, Korea
[Nationality] KR
[Inventor]
[Name] Jang Jin YOO
[Resident Reg.] 710208-1079817
[Postal] 137-030
[Address] Shinbanpo2jigu APT. 112-806, 73, Jamwon-dong, Seocho-gu, Seoul, Korea
[Nationality] KR
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[Statutory Basis] Pursuant to Art. 42 of the Patent Law, We apply as above, Pursuant to Art. 60 of the Patent Law, we submit this request for examination as above.

Patent Attorneys Yong In KIM

Chang Sub SHIM

[Fees]

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[Request for Examination]	12 claims	493,000 won
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[Affixes]
- A Copy of Abstract and Specification(and Drawings)

CERTIFICATE OF VERIFICATION

I, Su Hyun LEE of 648-23 Yeoksam-dong, Kangnam-ku, Seoul, Korea state that the attached document is a true and complete translation to the best of my knowledge of the Korean-English language and that the writings contained in the following pages are correct English translation of the specification and claims of the Korean Patent Application No. P2000-50430.

Dated this 15th day of December, 2003

Signature of translator: 

Su Hyun LEE

[ABSTRACT]

An in plane switching mode LCD device is disclosed, in which high response time is obtained and residual images are prevented from occurring. The in plane switching mode LCD device includes two substrates opposing each other, common electrodes arranged on one of the two substrates in a zigzag pattern, a pixel electrode arranged with a zigzag pattern corresponding to the common electrodes in parallel with the common electrodes, common electrode frames projected outside a bent portion in a direction of the common electrodes, pixel electrode frames projected outside a bent portion in a direction of the pixel electrode, and a liquid crystal provided between the electrodes having the electrode frames.

[TYPICAL DRAWINGS]

FIG. 4

[INDEX]

IPS

[SPECIFICATION]

[TITLE OF THE INVENTION]

IN PLANE SWITCHING MODE LIQUID CRYSTAL DISPLAY DEVICE

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG.1 is a layout illustrating a related art in plane switching mode LCD device.

FIG.2 is an enlarged view of a disinclination region in the related art.

FIG. 3 is an enlarged view of a region where electric field is uneven in the related art.

FIG. 4 is a schematic view of an electrode of an in plane switching mode LCD device according to the first embodiment of the present invention.

FIG. 5 is a schematic view of an electrode frame region according the first embodiment of the present invention.

FIGS. 6A and 6B are plane views of a dielectric frame region according to the second embodiment of the present invention.

FIGS. 7A and 7B are sectional views of the dielectric frame region according to the second embodiment of the present invention.

Description of reference numerals for main parts in the drawings

41, 74: common electrode	42, 73: pixel electrode
43: common electrode frame	44: pixel electrode frame
45: liquid crystal	46, 47: dielectric frame
71: lower substrate	72: upper substrate

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND DISCUSSION OF THE RELATED ART]

The present invention relates to a liquid crystal display (LCD) device, and more particularly, to an in plane switching mode LCD device that has a zigzag pattern electrode structure in which high response time is obtained and residual images are prevented from occurring.

In recent, research for an in plane switching mode LCD device is being performed to solve a problem of a twisted nematic (TN) mode LCD device having a narrow viewing angle. Also, research for improving viewing angle and color shift characteristics is being performed by forming an electrode of the in plane switching mode LCD in a zigzag pattern.

Hereinafter, a related art in plane switching mode LCD device will be described with reference to the accompanying drawings.

FIG. 1 is a layout illustrating the related art in plane switching mode LCD device. FIG. 2 is an enlarged view of a disinclination region in the related art. FIG. 3 is an enlarged view of a region where electric field is uneven in the related art.

The related art in plane switching mode LCD device includes a gate line 1, a data line 2, a common line 3, a thin film transistor (TFT) 6, a common electrode 4, and a pixel electrode 5. At this time, the gate and data lines 1 and 2 are arranged on a substrate to define a pixel region. The common line 3 is formed within the pixel region in parallel with the gate line 1, and the TFT 6 is formed in a portion where the gate line 1 crosses the data line 2. Also, the common electrode 4 and the pixel electrode 5 are arranged within the pixel region for being corresponding to each other in

a zigzag pattern in parallel.

In the related art in plane switching mode LCD device, if a voltage is applied from an external driving circuit, electric field parallel to the substrate occurs between the pixel electrode 5 and the common electrode 4, so that liquid crystal molecules rotate along the electric field, thereby displaying a picture image.

The related art in plane switching mode LCD device having a zigzag pattern electrode structure has the following characteristics due to its electrode structure.

FIG. 2 is an enlarged view of a portion "K" of FIG. 1. In this portion "K", disinclination occurs in which the liquid crystal molecules do not rotate. This is because that the electrode structure has a zigzag pattern. As a result, dynamic residual images occur and response time increases. In portions "A" and "B" of FIG. 2, the liquid crystal 7 moves depending on a pretwist angle and a direction of electric field. However, in a portion "C" where the pixel electrode 5 and the common electrode 4 are bent, the liquid crystal 7 does not move since no pretwist angle exists.

As described above, in case where the electrode structure has a zigzag pattern, the liquid crystal moves by driving not the electric field but periphery liquid crystals. Particularly, since the liquid crystal 7 in the portions "A" and "B" has a driving direction opposite to that of its adjacent liquid crystal 7 in the portion "C", the liquid crystal in the portion "C" may not be driven.

Furthermore, as shown in FIG. 3, in the in plane switching mode LCD device having two domains, uneven electric field occurs in a region 8 of FIG. 3 where the common electrode 4 is outwardly bent and the pixel electrode 5 is inwardly bent. In other words, the electric field generated to be perpendicular to the common electrode 4 and the pixel electrode 5 has an uneven arrangement in the region 8 without being

generated to be perpendicular to the common electrode 4 and the pixel electrode 5. In such case, response time of the liquid crystal molecules is reduced and dynamic residual images occur.

[TECHNICAL TASKS TO BE ACHIEVED BY THE INVENTION]

Accordingly, the related art in plane switching mode LCD device has the following disadvantages.

In case the electrode has a zigzag pattern to improve viewing angle and color shift characteristics, the liquid crystal may be operated by not the electric field but its adjacent liquid crystal. In this case, the electric field may be unevenly arranged. As a result, the response time becomes slow and the dynamic residual images occur, thereby deteriorating characteristic of the liquid crystal panel.

Accordingly, the present invention is directed to an in plane switching mode LCD device that substantially obviates one or more problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide an in plane switching mode LCD device in which a dielectric frame having a smaller dielectric constant than that of a liquid crystal or an electrode frame is formed in a portion where an electrode is bent, so that the liquid crystal is exactly operated, thereby obtaining high response time and preventing residual images from occurring.

[PREFERRED EMBODIMENTS OF THE INVENTION]

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, an in plane

switching mode LCD device includes two substrates opposing each other; a common electrode arranged on one of the two substrates in a zigzag pattern; a pixel electrode arranged with a zigzag pattern corresponding to the common electrodes in parallel with the common electrode; common electrode frames projected outside a bent portion in a direction of the common electrode; pixel electrode frames projected outside a bent portion in a direction of the pixel electrode; and a liquid crystal formed between the electrode having the electrode frames.

In another aspect, an in plane switching mode LCD device includes two substrates opposing each other; a common electrode arranged on one of the two substrates in a zigzag pattern; a pixel electrode arranged with a zigzag pattern corresponding to the common electrode in parallel with the common electrode; a dielectric frame partially overlapped with the pixel electrode, having a width gradually reduced toward the common electrode; and a liquid crystal formed between the electrodes having the dielectric frame.

The reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

Hereinafter, an in plane switching mode LCD device according to the present invention will be described with reference to the accompanying drawings. FIG. 4 is a schematic view of an electrode of an in plane switching mode LCD device according to the first embodiment of the present invention. FIG. 5 is a schematic view of an electrode frame region according the first embodiment of the present invention.

An in plane switching mode LCD device according to the first embodiment of the present invention includes a common electrode 41 having a zigzag pattern structure, a pixel electrode 42 arranged with a zigzag pattern corresponding to the common

electrode 41 in parallel with the common electrode 41, common electrode frames 43 projected to form at least two domains around a portion where the common electrode is bent, the domains controlling movement of a liquid crystal outside a portion where the electrode is bent at a smaller angle than 180° in a zigzag pattern of the common electrode 41, pixel electrode frames 44 projected to form at least two domains around a portion where the pixel electrode is bent, the domains controlling movement of a liquid crystal outside a portion where the electrode is bent at a smaller angle than 180° in a zigzag pattern of the pixel electrode 42, and a liquid crystal 45 formed between the frames.

In this state, the common electrode frames 43 are arranged in parallel with one another, and the pixel electrode frames 44 are also arranged in parallel with one another. Also, the common electrode frames 43 are located between two neighboring pixel electrode frames 44, and the pixel electrode frames 44 are located between neighboring common electrode frames 43. The pixel electrode frames 44 and the common electrode frames 43 are alternately arranged in one direction of a panel.

Each pixel electrode frame 44 and each common electrode frame 43 are not in contact with a corresponding common electrode 41 and a corresponding pixel electrode 42. The common electrode frame 43 is essentially located in a bent portion having a smaller angle than 180° in a direction of the pixel electrode 42. The pixel electrode frame 44 is essentially located in a bent portion having a smaller angle than 180° in a direction of the common electrode 41.

In the aforementioned in plane switching mode LCD device of the present invention, as shown in FIG. 5, the common and pixel electrode frames 43 and 44 form at least two domains in a portion where the common electrode 41 and the pixel

electrode 42 are bent, i.e., a portion where D where the common electrode frame 43 or the pixel electrode frame 44 is formed. The domains serve to drive the liquid crystal 45 by means of the electric field. This means that the operation range of the liquid crystal driven by not the electric field but a neighboring liquid crystal does not exist.

Hereinafter, an in plane switching mode LCD device according to the second embodiment of the present invention will be described with reference to the accompanying drawings. FIGS. 6A and 6B are plane views of a dielectric frame region according to the second embodiment of the present invention. FIGS. 7A and 7B are sectional views of the dielectric frame region according to the second embodiment of the present invention. In the second embodiment of the present invention, the common electrode 41 and the pixel electrode 42 are arranged in a zigzag pattern so as to prevent uneven electric field from occurring in a portion where the electrode is bent.

As shown in FIG. 6A, a dielectric frame 46 is formed to partially overlap the pixel electrode 42 and includes a dielectric material having a dielectric constant smaller than that of the liquid crystal. As shown in FIG. 6B, the dielectric frame 46 is formed to partially overlap the common electrode 41 and includes a dielectric material having a dielectric constant greater than that of the liquid crystal.

That is, in FIG. 6A, the dielectric frame 46 partially overlaps the pixel electrode 42 in a portion where electric field is unevenly generated, and its width is gradually reduced toward the common electrode 41 to form a wedge shape. In FIG. 6B, the dielectric frame 46 partially overlaps the common electrode 41 in a portion where electric field is unevenly generated, and its width is gradually reduced toward the pixel electrode 42 to form a wedge shape. This is to reduce the density of the electric field

so that the uneven electric field is minimized during driving of the liquid crystal. In this case, it is possible to change the shape of the dielectric frame 46 according to the bent angle of the common and pixel electrodes 41 and 42 and the distance between the two electrodes 41 and 42.

The dielectric frame 46, as shown in FIG. 6A, is formed inside a portion where the electrode is bent at a smaller angle than 180° in a zigzag pattern of the pixel electrode 42. Alternatively, the dielectric frame 46, as shown in FIG. 6B, is formed outside a portion where the electrode is bent at a greater angle than 180° in a zigzag pattern of the common electrode 41.

As shown in FIG. 7A, when there are an upper substrate 72, and a lower substrate 71 having the pixel electrode 73, the common electrode 74 and insulating layers 75a and 75b between the respective electrodes, the dielectric frame is partially overlapped with the common electrode 74 of the lower substrate 71, the dielectric frame 76 has a smaller thickness than a gap between the lower and upper substrates 71 and 72. By contrast, as shown in FIG. 7B, the dielectric frame 76 may have the same thickness as the distance between the lower substrate 71 and the upper substrate 72 so that it can serve as a spacer.

As mentioned above, the in plane switching mode LCD device according to the present invention has the following advantages.

The dielectric frame having a smaller dielectric constant than that of the liquid crystal is formed in a portion where the electric field is unevenly generated as it is converged in a bent portion of the electrode. This reduces the density of the electric field so that the uneven electric field is minimized during driving of the liquid crystal. In this case, high response characteristic can be obtained and residual images can be

prevented from occurring.

Likewise, the electrode frame is formed in a portion where the operation range of the liquid crystal operated by driving its neighboring liquid crystal not by the electric field exists, so that the liquid crystal can be exactly operated, thereby obtaining high response time and preventing residual images from occurring. Particularly, in case where the electrode frame is formed, it is possible to form at least two domains that move the liquid crystal in a portion where the electrode is bent.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. An in plane switching mode LCD device comprising:

two substrates opposing each other;

a common electrode arranged on one of the two substrates in a zigzag pattern;

a pixel electrode arranged with a zigzag pattern corresponding to the common electrodes in parallel with the common electrode;

common electrode frames projected outside a bent portion in a direction of the common electrode;

pixel electrode frames projected outside a bent portion in a direction of the pixel electrode; and

a liquid crystal formed between the electrode having the electrode frames.

2. The in plane switching mode LCD device of claim 1, wherein the respective common electrode frames are located between two neighboring pixel electrode frames, and the respective pixel electrode frames are located between neighboring common electrode frames.

3. The in plane switching mode LCD device of claim 1, wherein the respective common electrode frames and the pixel electrode frames are arranged in parallel with one another, and the pixel electrode frames and the common electrode frames are alternately arranged in one direction.

4. The in plane switching mode LCD device of claim 1, wherein the common

electrode frames are essentially located in a bent portion having a smaller angle than 180° in a direction of the pixel electrode, and the pixel electrode frames are essentially located in a bent portion having a smaller angle than 180° in a direction of the common electrode.

5. An in plane switching mode LCD device comprising:

two substrates opposing each other;

a common electrode arranged on one of the two substrates in a zigzag pattern;

a pixel electrode arranged with a zigzag pattern corresponding to the common electrode in parallel with the common electrode;

a dielectric frame partially overlapped with the pixel electrode, having a width gradually reduced toward the common electrode; and

a liquid crystal formed between the electrodes having the dielectric frame.

6. The in plane switching mode LCD device of claim 5, wherein the dielectric frame is formed inside a bent portion in a direction of the pixel electrode.

7. The in plane switching mode LCD device of claim 5, wherein the dielectric frame is formed of a dielectric material having a dielectric constant smaller than that of the liquid crystal.

8. The in plane switching mode LCD device of claim 5, wherein the dielectric frame has a thickness smaller than a spaced distance between the two substrates.

9. The in plane switching mode LCD device of claim 5, wherein the dielectric frame has a thickness equal to a spaced distance between the two substrates.

10. The in plane switching mode LCD device of claim 5, wherein the dielectric frame is partially overlapped with one portion of the common electrode, and has a width gradually reduced toward the pixel electrode.

11. The in plane switching mode LCD device of claim 10, wherein the dielectric frame is formed outside at a bent portion in a direction of the common electrode.

12. The in plane switching mode LCD device of claim 10, wherein the dielectric frame is formed of a dielectric material having a dielectric constant greater than that of the liquid crystal.

FIG.1
Related Art

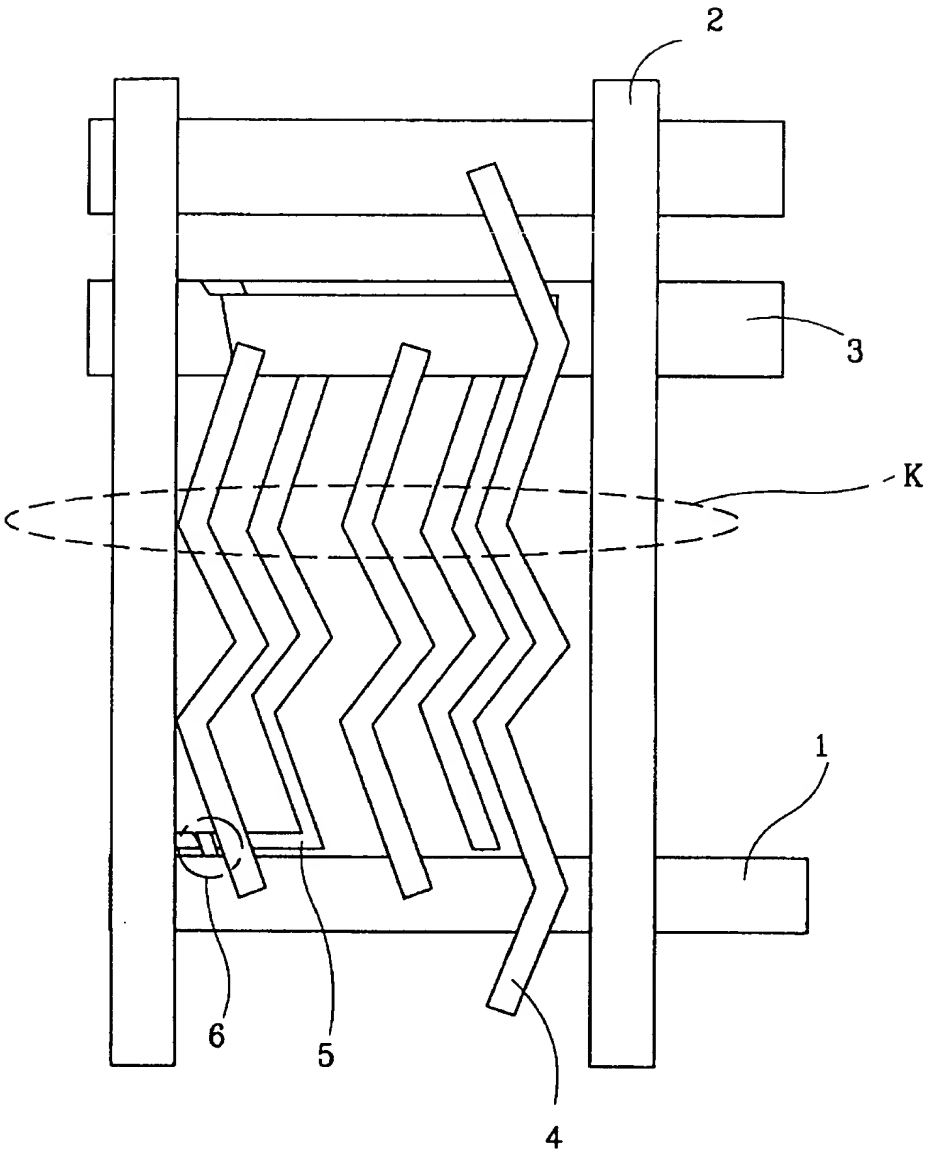
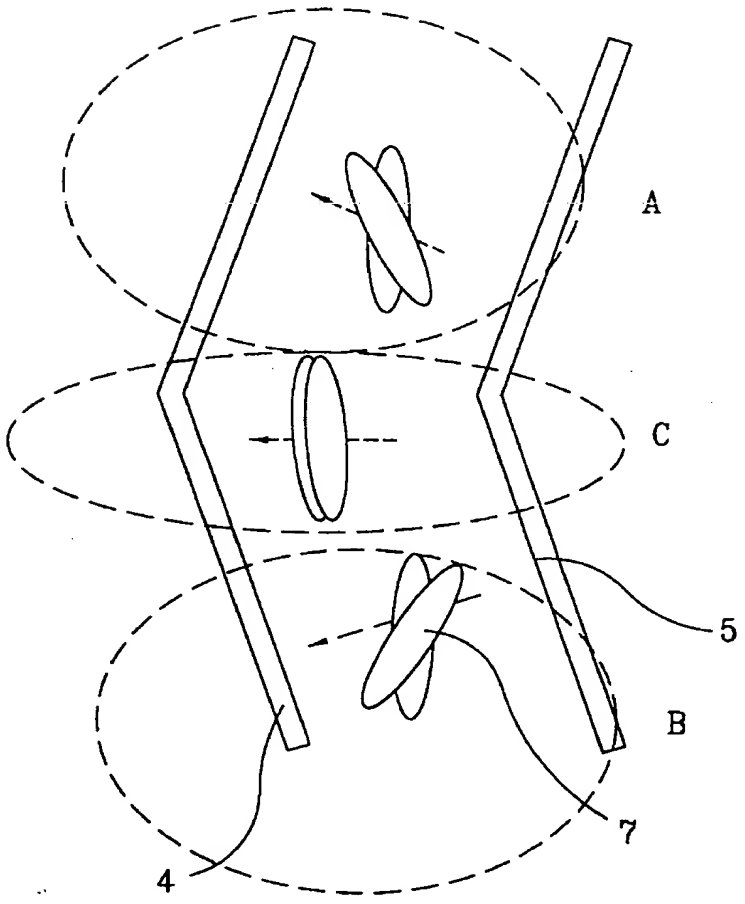


FIG.2
Related Art



direction of electric field

FIG.3
Related Art

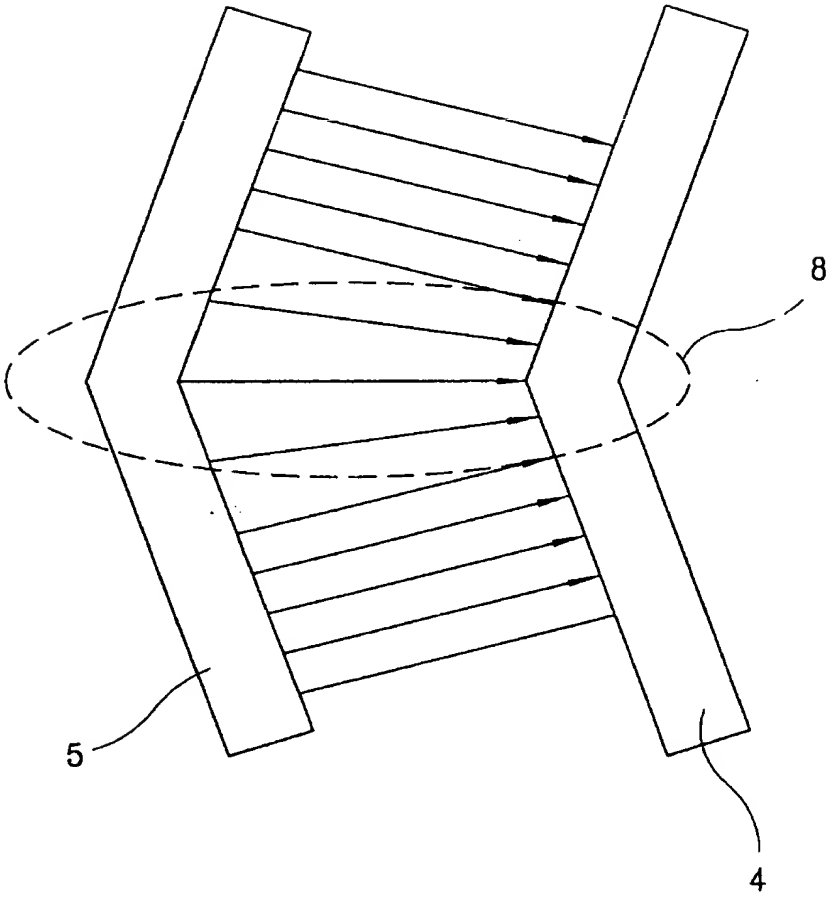


FIG. 4

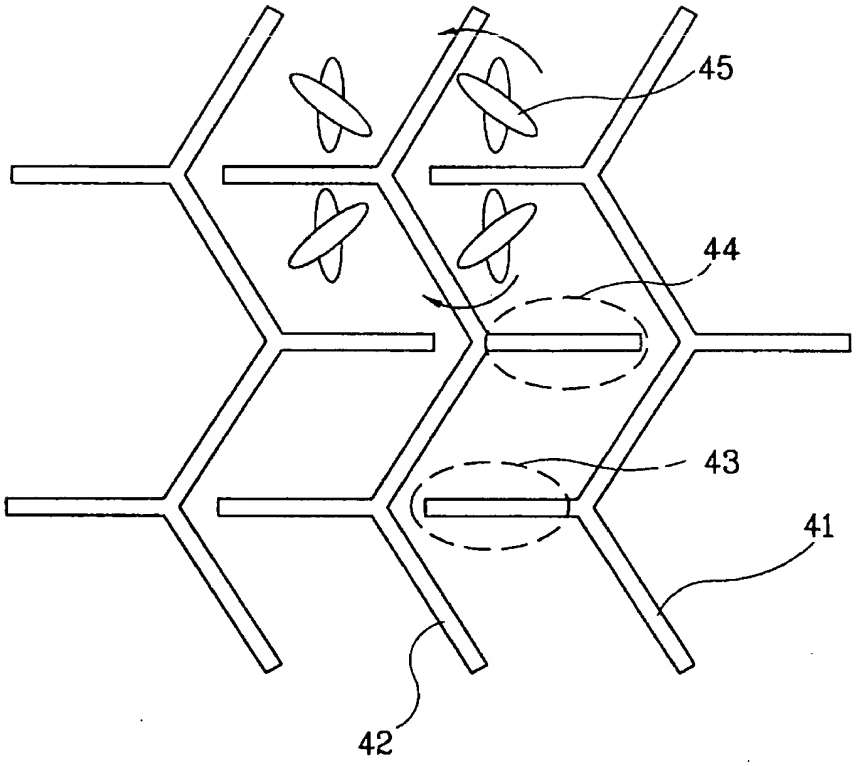


FIG.5

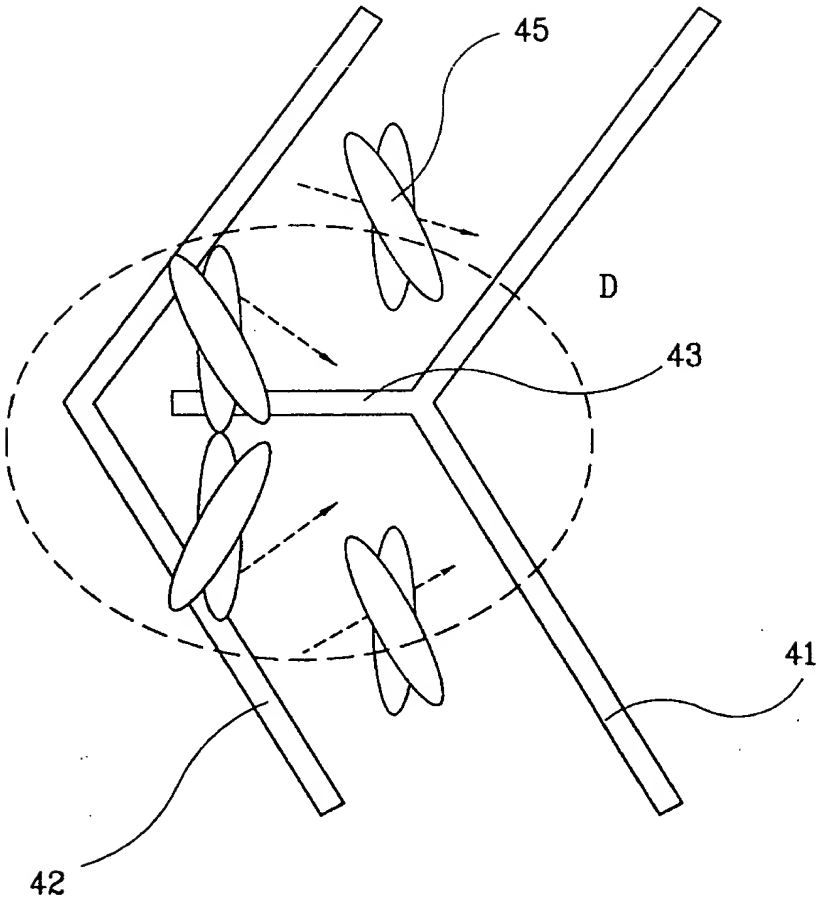


FIG.6a

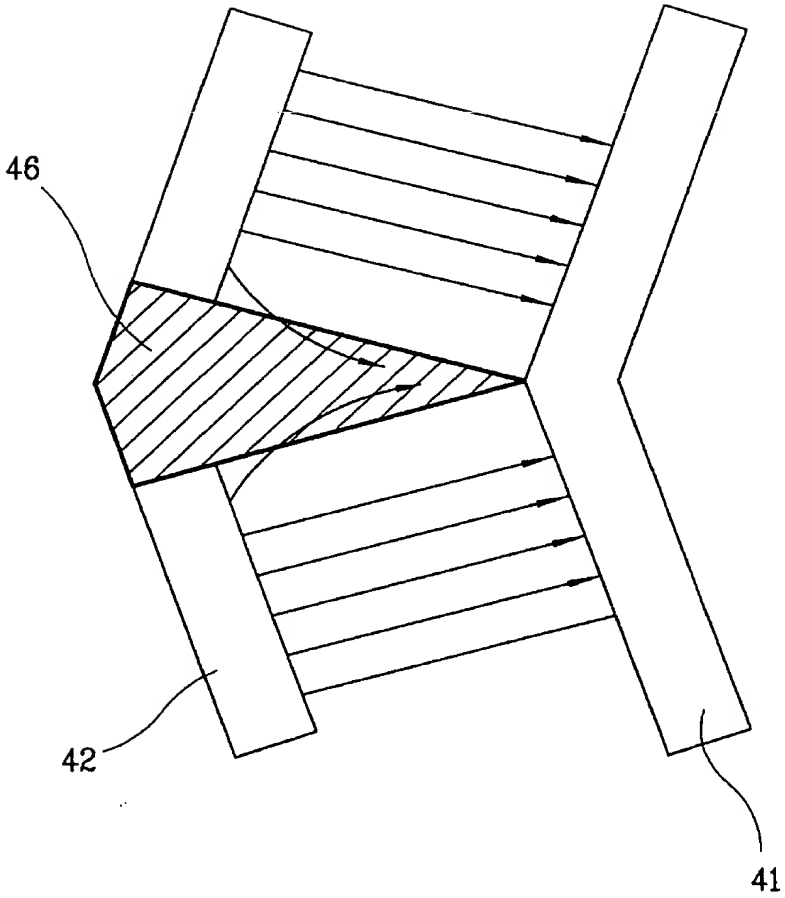


FIG.6B

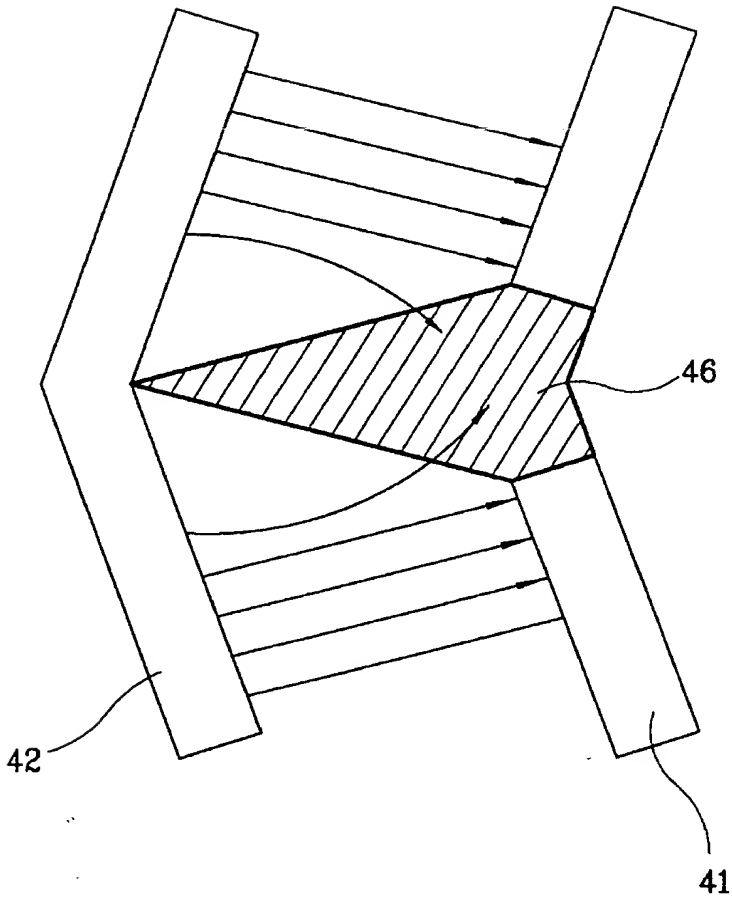


FIG. 7A

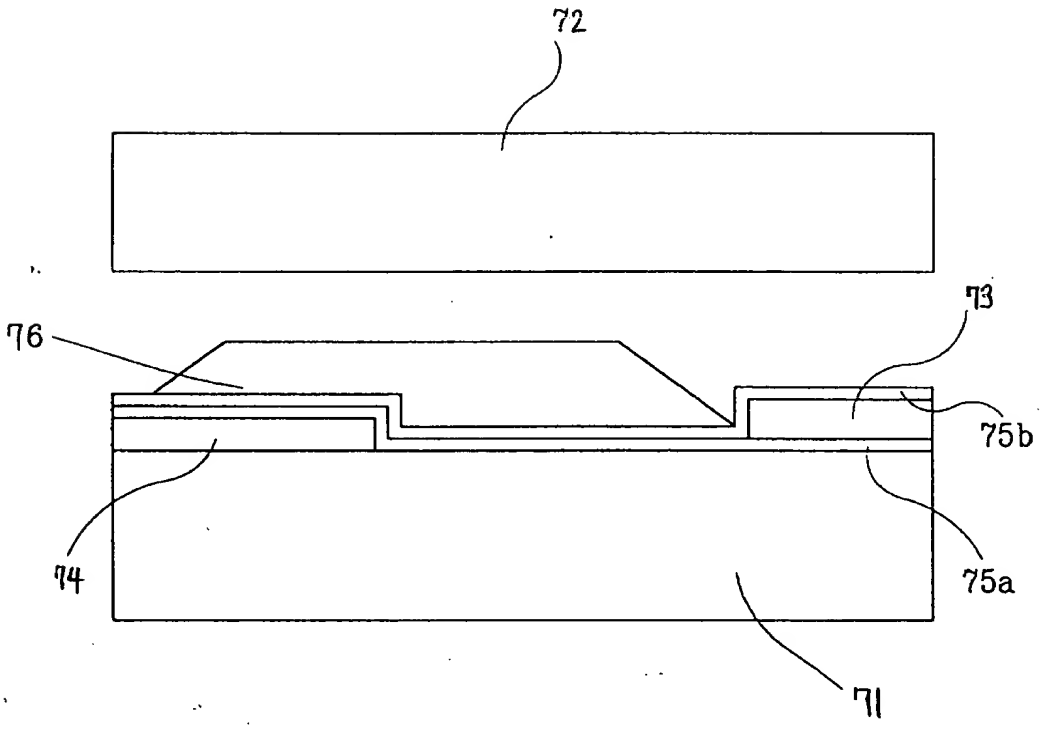


FIG. 7B